

SPECIFICATION

Docket No.: Piling-1

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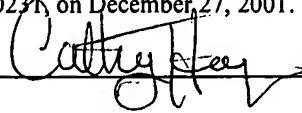
**APPARATUS FOR INSTALLING A WORKPIECE
BELOW A SURFACE**

of which the following is a specification:

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APPARATUS FOR INSTALLING A WORKPIECE BELOW A SURFACE

Field of the Invention

The present invention relates to an apparatus for installing a workpiece below a surface, e.g., in an underground location. More particularly, the present invention relates to an apparatus and method for installing an inground anchor, particularly
5 a plate or wing-type anchor.

Background of the Invention

There are occasions when it is necessary to install a workpiece in a substrate below a surface over the substrate; e.g., below the surface of a underground location. The two "substrate" as used herein is intended to mean any solid medium
10 having a surface albeit that the materials forming the surface and the substrate may be different. The workpiece can take the form of an anchor which is used in a variety of uses in the utility, civil engineering and construction fields. For example such anchors can be used for guying utility poles, retaining walls, sheet piles, and seawalls; for buoyancy control of pipelines, for erosion control systems; and in
15 underwater applications for anchoring moorings, docks and the like.

Types of anchor commonly used for the above described application are disclosed in U.S. Patent Nos. 3,969,854, 4,044,513, 4,096,673, 4,802,317 and 5,031,370 and are generally referred to as plate or wing-type anchors.

Summary of the Invention

In a preferred embodiment of the invention, there is provided an apparatus for installing a workpiece at a location below a surface. The apparatus includes an elongate track member having a first end positionable proximate, the surface, and
5 a second end positionable distal the surface. A carriage is slidably mounted on the track member. A hammer assembly is mounted on the carriage, the hammer assembly having a hammer head which is reciprocally movable relative to the carriage in a direction toward and away from the first end of said track member. An operator effects reciprocation of the hammer head. There is also an actuator to
10 compressively urge the carriage toward the first end of the track member.

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Brief Description of the Drawings

Fig. 1 is a side, elevational view showing the apparatus of the present invention installing an anchor in an underground location.

Fig. 2 is a side, elevational view of the apparatus of the present invention showing the apparatus being used to set the anchor which has been placed in an underground location.

Fig. 3 is a view taken along the lines 3-3 of Fig. 1.

Fig. 4 is a view taken along the lines 4-4 of Fig. 1.

Fig. 5 is a cross-sectional view taken along the lines 5-5 of Fig. 3.

Fig. 6 is a cross-sectional view taken along the lines 6-6 of Fig. 3.

Detailed Description of Preferred Embodiments

Turning first to Fig. 1, the apparatus of the present invention shown generally as 10 is seen as being positioned on the surface S of the ground G at a desired location. Apparatus 10 comprises an elongate track member shown generally as 12, a carriage, shown generally as 14, slidably mounted on track member 12, and a hammer assembly, shown generally as 16, mounted on carriage 14. In the embodiment shown in Fig. 1, track member 12 is attached by means of a bracket 18 to a support assembly shown in phantom generally as 20 and comprised of a movable boom 22 and a piston/cylinder assembly 24. Boom 22 and piston/cylinder assembly 24 are both pivotally attached to bracket 18 and accordingly can be used to move track member 12 and hence apparatus 10 to various desired attitudes or altitudes relative to the surface S of ground G. It will be understood that boom 22 and piston/cylinder assembly 24 can form part of a backhoe or other similar apparatus, commonly used in the construction field.

A hydraulic cylinder/piston assembly, shown generally as 26, is comprised of a cylinder 28 in which is disposed a piston (not shown) and a piston rod 30 and is operatively interconnected between track member 12 and carriage 14. As is well known to those skilled in the art, connected to cylinder 28 are hydraulic hoses attached to a suitable hydraulic power source, none of which are shown. As will be seen hereafter, two such cylinder/piston assemblies 26 can be used. One end 32 of cylinder 28 is attached to a lower or first end 34 of track member 12 via a clevis arrangement 35 while the end 36 of piston rod 30 which extends from cylinder 28

is attached to carriage 14 via another clevis arrangement 15. Pivottally attached to the lower end 34 of track member 12 is a footer 38 which rests on the surface S of the ground G. It will thus be seen that if the piston rod 30 is moved in the direction of arrow A, carriage 14 will move in the direction of arrow B, i.e., toward end 34 of track member 12.

Hammer assembly 16 is provided with a hammer head 40 which engages the outermost end of a driving rod 42 of an anchor assembly, shown generally as 44. Anchor assembly 44, commonly referred to as a "plate" or "wing type" anchor, is described in one or more of U.S. Patent Nos. 3,969,854, 4,044,513, 4,096,673, 4,802,317, and 5,031,370 (hereinafter Anchor Patents) incorporated hereinafter by reference for all purposes, and comprises an all-thread pull or setting rod 46 attached to the anchor 45. It will be understood that while the apparatus 10 of the present invention is being described with reference to a particular anchor assembly, i.e., anchor assembly 44 as described in various of the Anchor Patents, the invention is not so limited and can be used to position a number of different types of workpieces, anchors or the like at a desired underground location. Thus, the term "workpiece" as used herein is intended to include any member or assemblage of members which has at least one end which can be forced, e.g., hammered, into a position in a substrate below a surface which overlies the substrate, and at least a second end which can be engaged by the hammer head 40 of the apparatus of the present invention. It is also to be understood that the term "surface" as used herein is intended to include the surface of materials such as asphalt, concrete and

the like as well as referring to seabeds, lakebeds, riverbeds and the like. Further, the term "surface" or "ground surface" is not limited to generally horizontal surfaces but is intended to include any surface at any angle whether it be horizontal or at some angle to the horizontal.

5 Hammer assembly 16 is conveniently of the hydraulic or air hammer type which effects percussive movement of hammer head 40 as indicated by multiple arrows C. As is well known, percussion, jack or air hammers are generally of a type which are activated by compressive engagement with the tool or surface to be struck. Accordingly, as hammer head 40 engages the end of drive rod 42 it acts to
10 percussively drive rod 42 and hence anchor assembly 44 into the ground G. As hammer head 40 percussively drives drive rod 42 of anchor assembly 44 into the ground G, the compressive force exerted on carriage 14 by piston/cylinder assemblies 26 ensures that hammer head 40 stays in percussive driving engagement with drive rod 42.

15 As shown in Fig. 1, anchor assembly 44 has been driven to the desired depth into the ground G. At the commencement of installing the anchor assembly 44 into the ground G, the cruciform end portion 48 of the anchor 45 of anchor assembly 44 could be driven, manually if necessary, a short distance below the surface S for purposes of positioning it at the desired location and attitude relative to surface S.
20 At this point, apparatus 10 could be positioned such that hammer head 40 was generally concentrically aligned with drive rod 42. Piston/cylinder assembly 26 could then be actuated to compressively urge carriage 14 toward drive rod 42, i.e.,

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towards the end 34 of track member 12, until hammer head 40 compressively engaged drive rod 42 whereupon hammer head 40 would begin its percussive striking of drive rod 42. As disclosed in the Anchor Patents, successive sections of drive rod 42 can be secured together by couplings such that anchor assembly 44
5 can be driven to virtually any desired depth. As taught in at least some of the Anchor Patents, the drive rod 42 is removably attached to anchor assembly 44. Accordingly, when the depth desired of anchor assembly 44 is reached, the drive rod(s) 42 can be removed.

Turning now to Fig. 2, there is shown the apparatus 10 of the present invention used to set the anchor assembly 44. As noted above, anchor assembly
10 44 includes an all thread setting rod 46 which, as shown in Fig. 2 can be extended to virtually any length by a series of threaded couplings 50 which can be used to secure excessive lengths of setting rod 46 together. In any event, the end of setting rod section 46 distal anchor 45 below ground is attached to a threaded eye 52. A
15 yoke or harness assembly 54 is attached to eye 52 and to carriage 14. In effect, harness 54 is comprised of a section of cable 55 welded or otherwise secured on each end to an eye 56 which can be secured to carriage 14 by means of a nut/bolt combination 58 which extends through carriage 14.

As described in U.S. Patent No. 4,802,317, to set the anchor 45 of anchor
20 assembly 44, the pull or setting rod 46 is pulled by a suitable pulling tool in a direction generally along the axis of the pull rod 46. This results in the cruciform end 48 of anchor assembly 44 being pulled to the position shown in Fig. 2, i.e., with

the anchor 45 basically pulled to a traverse or flat position in the ground. The apparatus of the present invention serves not only to position the anchor assembly 44 at a desired location below the surface S, but performs the function of a pulling or setting tool. Thus, if piston rod 30 is extended to the position shown in Fig. 2, i.e., in the direction of arrow D, carriage 14 will move in the direction of arrow D and exert an upward force on pull or setting rod 46, the upward force being transmitted through the harness assembly 54 and the eye 52 to pull setting rod 46 up and move anchor 45 to the set position shown in Fig. 2.

Reference is now made to Figs. 3-6 for a detailed description of the construction of the apparatus 10 of the present invention. With reference first to Figs. 3-6, it can be seen that track member 12 is comprised of an elongate box beam 60 having welded or otherwise secured thereto on opposite sides angle irons 62 and 64. As can be seen, angle irons 62, 64 form flanges 66 and 68, respectively, which extend laterally outwardly from opposite sides of box beam 60.

Carriage 14 as best seen in Figs. 3, 5 and 6 comprises a pair of spaced side plates 70 and 72 which are held together by a series of nut and bolt assemblies 74 as described more fully hereafter. Welded or otherwise secured to the inside surface of side plate 70 are first and second spaced ribs 76 and 78, ribs 76 and 78 projecting laterally inwardly from side plate 70 toward side plate 72. As best seen in Fig. 3, a key plate 78 extends generally parallel to side plate 70 and is welded or otherwise secured to ribs 76 and 78. Key plate 78 is provided with a dog 80 which projects laterally inwardly from key plate 78, i.e., towards side plate 72. In like

fashion, side plate 72 is attached to spaced ribs 82 and 84 which project laterally from the inside surface of side plate 72 and are connected to a longitudinally extending second key plate 86, key plate 86 carrying a dog 88 which projects laterally from key plate 86 toward side wall 70. The purpose of dogs 80 and 86 will
5 be described hereafter.

Carriage 14 is provided with a first set of upper roller assemblies and a second set of lower roller assemblies, described hereafter. The upper set of roller assemblies, best seen with reference to Figs. 5 and 6, are comprised of a shaft 90 on which is rotatably mounted a sleeve 92, sleeve 92 being attached at opposite
10 ends to wheels 94 and 96. Although not shown, there are bushings between side plates 70 and wheel 94 and side plate 72 and wheel 96 to maintain the roller assemblies in a predetermined position between the side plates 70, 72. Shaft 90 is threaded at its opposite ends and extends through suitable holes in plates 70 and 72, the threaded ends of shaft 90 being secured to the carriage 14 by means of nuts
15 98. There are a series of three such upper roller assemblies spaced along the length of carriage 14 as best seen with reference to Figs. 3 and 6. It will be appreciated that the upper roller assemblies described above also serve the purpose of urging side plates 70 and 72 together.

In addition to the upper set of roller assemblies discussed above, there are
20 a lower set of roller assemblies, which number 3, and are also attached to carriage 14 and spaced along the length thereof. Two of the lower roller assemblies are as described above with respect to the upper roller assemblies. The third lower roller

assembly differs in that they are not comprised of a shaft which extends through both the side plates 70 and 72. Rather, as seen in Figs. 5 and 6, the third lower roller assembly comprises a mount 100 secured to leg 63 of angle iron 62. Fixedly received in mount 100 is one end of a shaft 101, shaft 101 extending through side plate 70 and being secured thereto by nut 106. Rotatably mounted on shaft 101 is a sleeve 108, sleeve 108 carrying a wheel 102 and being rotatable around shaft 101. In a similar fashion, and as seen in Figs. 5 and 6, a second such lower roller assembly is disposed between side plate 72 and one leg 65 of angle iron 64.

As can be seen, the upper and lower roller assemblies are positioned on carriage 14 such that the flanges 66 and 68 are sandwiched between the wheels, flanges 66 and 68 effectively forming a rail or track for the wheels of the roller assemblies. Thus, carriage 14 via the roller assemblies and flanges 66 and 68, can move reciprocally along the length of track member 12. While carriage 14 has been described in connection with the use of roller assemblies to enable carriage 14 to move along track member 12, it is to be understood that the use of rollers is not necessary and that provision could be made to slidably mount carriage 14 on track member 12, i.e., the use of rollers could be dispensed with. To this end, carriage 14 could be provided with pads made of a low friction material which would slide on a suitable surface(s) forming part of track member 12. It will be apparent that other assemblies can be used to permit the reciprocal movement of carriage 14 along track member 12.

Turning now to Figs. 3 and 6, the hammer assembly 16 is shown in greater detail. Hammer assembly 16 includes a housing 110 which, as seen in Fig. 3, has a pair of slots or keyways 112 and 114 on opposite sides of housing 110, keyway 112 opening in a direction toward side plate 70, keyway 114 opening in a direction toward side plate 72. Received in keyway 112 is dog 80 which acts as a key. As well, dog 88 acts as a key and is received in keyway 114. It can be seen that this keyed relationship between carriage 14 and hammer assembly 16 prevents any relative longitudinal movement between carriage 14 and housing 110. However, it can also be seen that when mounting hammer assembly 16 in carriage 14, and prior to nut and bolt assemblies 74 being engaged, hammer assembly 16 can be effectively inserted into carriage 14 in a direction transverse to the longitudinal axis of carriage 14 so that the keys 80, 88 engage the keyways 112, 114, respectively. Although not shown, it will be apparent to those skilled in the art that when hammer assembly 16 is of the percussion type, e.g., a hydraulic or air hammer it would be supplied with suitable compressed fluid or air via a suitable source and hoses (not shown) to power hammer head 40 in its percussive movement. Preferably, hammer assembly 16 is of the hydraulic powered type which obviates the necessity for having a compressed air source for a pneumatic hammer and a hydraulic fluid source for the piston/cylinder assemblies 26, i.e., both the hammer assembly 16 and the piston/cylinder assemblies 26 can utilize the same power source.

As described above, apparatus 10 is provided with support assembly 20 which acts to hold the apparatus 10 in a predetermined position. As was also noted

above, the support assembly 20 can be part of a backhoe or other motorized piece of construction equipment commonly used to hold and, if necessary or desired, to vary the position or angle of the member being held. However, it will be recognized that such a support assembly is not necessary. For example, apparatus 10 could be provided with a plurality of footers such that the apparatus could be moved to the desired location and placed there. Once the job of installing the workpiece was completed, the apparatus could then be picked up and moved to another location. However, it is more convenient, particularly when multiple workpieces, e.g., anchors, are being installed to have apparatus 10 mounted on a backhoe or the like to facilitate positioning it in a predetermined location and changing its attitude with respect to the surface into which the workpiece is being driven. A support such as support assembly 20 can be employed to maintain or exert a downward force on the apparatus 10 such that footer 38 is held firmly against the surface S. However, the apparatus could simply be made heavy enough such that, once placed in a desired location, the weight would be sufficient to withstand the reactive forces generated by compressively urging the carriage 14 in a generally downward direction coupled with the reactive forces generated by hammer assembly 16. In this regard it is to be noted that while the actuator to compressively urge the carriage 14 and hence the hammer head 40 against the drive rod 42 is shown as a conventional hydraulic piston/cylinder arrangement, it is to be understood that the piston/cylinder assemblies could be dispensed with in favor of other mechanisms. For example, carriage 14 could be mounted on a rack and pinion mechanism, the pinion being

rotatably attached to the carriage 14 and being driven in a suitable fashion. Additionally, a powered jack screw could be employed to compressively urge the carriage 14 against the workpiece. It is also to be understood that while far less desirable, a weight suspended from the boom of a crane or like could be positioned on and lifted off of carriage 14, the weight serving as the actuator to compressively urge carriage 14 towards the first or lower end 34 of the track member number 12.

While preferred embodiments of the present invention have been illustrated in detail, it is apparent that modifications and adaptations of the preferred embodiments will occur to those skilled in the art. However, it is to be expressly understood that such modifications and adaptations are within the spirit and scope of the present invention as set forth in the following claims.